

NEW CLAIMS 114 – 176

114. A wheel, comprising:

a peripheral wheel rim;

a central hub with a central axle and an outer flange;

a plurality of spokes extending between the rim and hub, wherein said spokes have a first portion connected to said rim and a second portion opposed to said first portion and connected to said hub; and

a cavity formed within at least one of said outer flange and said rim for connection with at least one of said spokes,

wherein at least one of said first portion and said second portion of at least one of said spokes is joined to at least one of said outer flange and said rim by means of a deformed engagement in a deformed engagement region wherein at least one of (1) said cavity is deformed by said spoke and (2) said spoke is deformed by said cavity; and

wherein said deformed engagement results in a connection to resist relative movement between said cavity and said at least one of said first portion and said second portion of said spoke at said engagement region.

115. A wheel according to claim 114, wherein at least one of said spokes is pretensioned.

116. A wheel according to claim 115, including means to pretension said spoke.

117. A wheel according to claim 116, wherein said means to pretension said spoke includes means for selectively adjusting said pretension.

118. A wheel according to claim 117, wherein said means for selectively adjusting said pretension includes a threadable adjustment means.

119. A wheel according to claim 114, wherein said cavity is a preformed cavity and wherein at least one of (1) said preformed cavity is deformed by said spoke and (2) said spoke is deformed by said preformed cavity

120. A wheel according to claim 114, wherein said cavity is in a polymeric material.

121. A wheel according to claim 120, wherein said polymeric material includes reinforcement fibers.

122. A wheel according to claim 120, wherein said polymeric material is a thermoplastic polymeric material.

123. A wheel according to claim 114, wherein said deformed engagement region is entirely within said cavity.

124. A wheel according to claim 114, including a plurality of said deformed engagement regions.

125. The wheel of claim 114 wherein at least one of said first portion and said second portion of said at least one of said spokes is coupled to at least one of said outer flange and said rim by means of an interference fit.

126. A wheel according to claim 114, wherein at least one of said first portion and said second portion of at least one of said spokes is joined to said cavity to maintain at least one of said cavity and spoke in a deformed condition.

127. A wheel according to claim 114, wherein there is a difference in hardness between the material of said cavity and the material of said spoke in said deformed engagement region, with at least one of said spoke and said cavity being softer than the mating spoke or cavity.

128. A wheel according to claim 127, wherein said deformed engagement region includes deformation of said softer material by said harder material.

129. The wheel of claim 114 wherein the deformed engagement region includes contact between said at least one spoke and said cavity around the full cross-sectional perimeter of said spoke in at least a portion of said deformed engagement region.

130. A wheel according to claim 114, wherein said cavity only partially surrounds the cross section of said at least one of said spokes in at least a portion of said deformed engagement region.

131. A wheel according to claim 114, wherein said cavity is a blind cavity including at least one open end and closed longitudinal sides and a closed bottom.

132. A wheel according to claim 114, wherein said cavity is a through cavity with a first open end and a second open end opposed to said first open end.

133. A wheel according to claim 132, with a first of said at least one of said spokes extending from said first open end and a second of said at least one of said spokes extending from said second open end.

134. The wheel of claim 114 wherein the deformed engagement comprises elastic deformation.

135. The wheel of claim 114 wherein the deformed engagement comprises plastic deformation.

136. A wheel according to claim 114, wherein said spoke includes a non-circular cross-section portion located within said deformed engagement region to limit rotation of said spoke relative to said cavity.

137. A wheel according to claim 114, wherein said at least one of said outer flange and said rim includes raised external geometry adjacent said cavity to at least one of locally extend and locally support said deformed engagement region.

138. A wheel according to claim 114, including at least one reinforcement element connected to at least one of said rim and said outer flange, wherein said reinforcement element serves to reinforce said at least one of said rim and said outer flange to resist stress and deflection associated with spoke tensile forces.

139. A wheel according to claim 138, wherein said reinforcement element is connected to said outer flange and is a continuous annular element, including a central opening to surround said axle and wherein said reinforcement element provides at least one of radial and hoop stresses reinforcement to said outer flange.

140. A wheel according to claim 114, wherein said cavity includes a configured surface in said deformed engagement region and said at least one of said spokes at least partially conforms to said configured surface of said cavity.

141. A wheel according to claim 114, wherein said at least one of said spokes includes a configured surface in said deformed engagement region and wherein said cavity at least partially conforms to said configured surface of said spoke.

142. A wheel according to claim 141, wherein said configured surface of said at least one of said spokes includes helical threads in said deformed engagement region.

143. A wheel according to claim 141, wherein said configured surface of said at least one of said spokes includes annular ribs in said deformed engagement region.

144. A wheel according to claim 141, wherein said configured surface of said at least one of said spokes includes at least one raked edge in said deformed engagement region, wherein said raked edge is raked in a direction to provide a ramped surface for reduced spoke insertion force into said cavity and a sharp edge for increased spoke pull-out force from said cavity.

145. The wheel of claim 114, including an intermediate connecting member connected to said spoke, wherein said deformed engagement is between said intermediate connecting member and said at least one of said outer flange and said rim.

146. A wheel according to claim 145, wherein said intermediate connecting member is a collar that surrounds the cross section of said at least one of said spokes.

147. A wheel according to claim 114, wherein said at least one of said spokes has a spoke span portion extending between said outer flange and said rim and wherein said spoke span portion

has a generally flat cross-section with a cross-sectional width greater than its thickness and wherein said cross-sectional width is aligned to extend in a generally tangential direction for reduced aerodynamic resistance in the direction of wheel rotation.

148. A wheel according to claim 114, wherein at least one of said cavity and said at least one of said spokes includes an extendable engagement surface in said deformed engagement region, wherein said extendable engagement surface creates an overlaid engagement between said extendable engagement surface and the other of said spoke and said cavity.

149. A wheel according to claim 148, wherein said extendable engagement surface is operative for passive retraction.

150. A wheel according to claim 114, wherein said cavity has an open end and a second end opposed to said open end, wherein said second end is at least partially closed and wherein said spoke contacts said second end to provide a longitudinal depth stop for said spoke.

151. A wheel according to claim 114, including a first spoke and a second spoke engaged within a common one of said cavity in said deformed engagement region.

152. A wheel according to claim 151, wherein said first spoke is engaged with said second spoke.

153. A wheel according to claim 114, including a clamping member, wherein said at least one of said spokes is sandwiched and gripped in said deformed engagement region by said clamping member.

154. A wheel according to claim 114, including a spoke joining member connected to said at least one of said rim and said outer flange, wherein said spoke joining member includes said cavity, and wherein said at least one of said spokes is engaged to said cavity at said deformed engagement region.

155. A wheel according to claim 154, wherein said spoke joining member is an annular element, including a central opening to surround said central axle.

156. A wheel according to claim 114, including a generally straight spoke span portion extending between said outer flange and said rim and wherein said spoke span portion has a longitudinal axis and wherein said deformed engagement region has a longitudinal axis and wherein said longitudinal axis of said spoke span portion is aligned to be generally collinear with said longitudinal axis of said deformed engagement region.

157. A wheel according to claim 114, wherein said at least one of said spokes is bent in a bent region external to said deformed engagement region.

158. A wheel according to claim 157, wherein said cavity is aligned in a generally axial orientation.

159. A wheel according to claim 157, wherein at least one of said rim and said outer flange includes a spoke guiding portion that is located external to said deformed engagement region, wherein said spoke guiding portion serves to support said spoke in said bent region.

160. A wheel according to claim 114, wherein said at least one of said spokes is a duplex spoke constituting a continuous element with two structural spans between said rim and said central hub, including a common portion joined to said cavity in said deformed engagement region.

161. A wheel according to claim 114, wherein said spoke is disassemblable from said cavity without damaging said cavity and wherein said spoke is reassemblable to said cavity after disassembly to reestablish said connection to resist relative movement between said spoke and said cavity.

162. A wheel according to claim 114, wherein:

said outer flange is a first outer flange for said connection with said second portion of a first of said spokes;

said central hub comprises a second outer flange joined to said second portion of a second of said spokes; and

said first outer flange is axially separated from said second outer flange by a spacer portion.

163. A wheel according to claim 162, wherein said first outer flange and said second outer flange are separate pieces, and wherein said first outer flange is rotatably keyed relative to said second outer flange to maintain a fixed angular orientation between said first outer flange and said second outer flange.

164. A wheel according to claim 162, wherein said first outer flange and said second outer flange are separate pieces, including means for fastening said first outer flange to said second outer flange so that said first outer flange and said second outer flange may be detached and reattached.

165. A wheel according to claim 162, wherein said first outer flange, said second outer flange and said spacer portion are formed as a single contiguous unit.

166. A wheel according to claim 114, wherein:

said cavity includes at least one open end and at least one longitudinal sidewall surface;  
said deformed engagement is a longitudinal deformed engagement in a longitudinal engagement region, comprising at least one of a continuous longitudinal deformed engagement and a multiplicity of longitudinally spaced discontinuous deformed engagement locations over a longitudinal distance along said longitudinal sidewall surface;

said spoke has a cross-sectional thickness in said longitudinal deformed engagement region; and

said longitudinal distance is greater than said cross-sectional thickness;

167. The wheel of claim 166 wherein said longitudinal distance is at least 2 times said cross-sectional thickness.

168. A wheel according to claim 166, wherein said at least one of said rim and said outer flange includes a first cavity associated with a first longitudinal deformed engagement region and a second cavity associated with a second longitudinal deformed engagement region, wherein said first cavity is at least one of radially and axially offset from said second cavity.

169. A wheel according to claim 166, wherein said longitudinal deformed engagement region is an obliquely extending engagement region that is radially offset from the central axial axis of said axle and wherein said longitudinal deformed engagement region extends through an imaginary radial line perpendicular to the central axial axis of said central hub and perpendicular to a longitudinal axis of said cavity.

170. A wheel according to claim 166, including a first longitudinal engagement region associated with a first spoke and a second longitudinal engagement region associated with a second spoke, wherein:

said first longitudinal deformed engagement region is an obliquely extending engagement region that is radially offset from the central axial axis of said axle;

said first longitudinal deformed engagement region is crossed over said second longitudinal deformed engagement region as viewed in the axial plan view, resulting in a crossover region of close proximity between said first longitudinal deformed engagement region and said second longitudinal deformed engagement region.

171. A wheel according to claim 170, including an angle of crossover between said first longitudinal deformed engagement region and said second longitudinal deformed engagement region, wherein said angle of crossover, as measured radially outwardly from said crossover region in the axial plan view, is less than 180 degrees.

172. A wheel according to claim 170, including an angle of crossover between said first longitudinal deformed engagement region and said second longitudinal deformed engagement region, wherein said angle of crossover, as measured radially outwardly from said crossover region in the plan view, is greater than or equal to 180 degrees.

173. A wheel according to claim 170, including a third longitudinal engagement region associated with a third spoke, wherein:

said first longitudinal deformed engagement region extends to cross over said third longitudinal deformed engagement region as viewed in the axial plan view, resulting in a second crossover region of close proximity between said first longitudinal deformed engagement region and said third longitudinal deformed engagement region; and



said first longitudinal deformed engagement region serves as a reinforcing span between said crossover region and said second crossover region.

174. A wheel according to claim 170, wherein said outer flange includes a multiplicity of said reinforcing spans associated with a multiplicity of said crossover regions, wherein said reinforcing spans are interconnected by means of said crossover regions to provide a full circumference of said reinforcing spans to provide hoop strength reinforcement of said outer flange about its axial axis.

175. A wheel according to claim 114, wherein said cavity is located in said rim, and wherein said deformed engagement provides a firm connection between said at least one of said spokes and said rim.

176. A wheel according to claim 114, wherein said cavity is located in said outer flange, and wherein said deformed engagement provides a firm connection between said at least one of said spokes and said outer flange.